

Appl. No. 10/783,495
Amdt. Dated 12/09/2009
Resp. to 09/15/2009 Off'l action

Attorney Docket No.: N1085-00251
[TSMC2003-0834]

REMARKS/ARGUMENTS

Claims 1 and 3-22 are pending in this application and each was rejected in the subject Office action. No claim amendments are filed herein. Applicants respectfully request re-examination, reconsideration and allowance of each of pending claims 1 and 3-22.

I. Comments with Respect to Examiner's Response to Arguments

In Applicants' previously-filed Response filed August 25, 2009, Applicants did not intend to characterize the Examiner's position in the referenced Examiner Interview as agreeing with Applicants with respect to the Lensing reference vis-à-vis the deficiencies of Park.

Applicants point out that in Applicants' previously filed Response, Applicants stated:

The Examiner acknowledged that amended claims 1 and 12 are distinguished from Park and Lensing has been relied upon for controlling the exposure energy as opposed to the exposure time as taught in Park, but Lensing does not make up for the above-stated and acknowledged deficiencies of Park.

Applicants were stating that the Examiner acknowledged that amended claims 1 and 12 are distinguished from Park.

The remainder of this sentence was not intended to characterize the Examiner's position, but, rather was an expression of Applicants' position.

II. Claim Rejections

In paragraph 6, claims 1, 3, 4 and 9-11 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Park, U.S. Patent No. 6,825,912 in view of U.S. Patent No. 6,630,362 to Lensing, hereinafter "Lensing" and further in view of U.S. Patent No. 6,532,428 to Toprac. In paragraph 13, claims 5-8 and 12-22 were rejected under

Appl. No. 10/783,495
Amdt. Dated 12/09/2009
Resp. to 09/15/2009 Off'l action

Attorney Docket No.: N1085-00251
[TSMC2003-0834]

35 U.S.C. § 103(a) as being unpatentable over Park in view of Lensing and Toprac, and in further view of U.S. Patent No. 6,798,529 to Saka, et al. (hereinafter "Saka").

Applicants respectfully submit that each of these claim rejections is overcome for reasons set forth below.

5 First and foremost, each of independent claims 1 and 12 is believed distinguished from Park in view of Lensing and Toprac because a) one would absolutely not combine the teachings of Park with the teachings of Lensing and/or Toprac to produce the claimed invention as proposed by the Examiner and b) even if one were to attempt to combine the references, the claimed invention would not result.

10 a) The Park reference is titled: SYSTEM FOR ADJUSTING A PHOTO-EXPOSURE TIME. The stated and only objective of the Park reference is to change exposure time, not exposure energy. The Park reference therefore cannot be used to support an obviousness rejection based on modifying the Park reference to change the exposure energy, as such would at least be counterintuitive. Moreover, Applicants
15 submit that Park teaches away from changing exposure energy as his entire disclosure is directed to *precluding the need to alter or control exposure energy*. If one of ordinary skill in the semiconductor manufacturing art, was considering aspects of the Park reference to control exposure time and, INSTEAD, decided to control the exposure energy, the Park reference would no longer be applicable or useful, so one would NOT
20 combine the Park reference with a reference directed to altering exposure energy such as Lensing, to control exposure energy.

Claims 1 and 12 are distinguished from the references at least because Park is acknowledged not to disclose the claimed invention and one would not combine Park with Lensing and/or Toprac.

25 b) None of the references, nor any combination thereof, teach or suggest the use of thickness or a thickness variation measurements of a subjacent layer to generate a feed forward signal to control the exposure energy of a top (i.e., *different*) device

Appl. No. 10/783,495
Amdt. Dated 12/09/2009
Resp. to 09/15/2009 Offl action

Attorney Docket No.: N1085-00251
[TSMC2003-0834]

layer, the top device layer recited as a non-photoresist layer, as in independent claims 1 and 12. In particular, independent claim 1 recites:

controlling the exposure energy with a feed forward process control signal of a compensation amount that compensates for thickness variations in a *subjacent layer* beneath a *top layer*, by combining the feed forward process control signal with the feedback process control signal to control the exposure energy used in patterning the *top layer*; and

the top layer being a non-photoresist layer.

Independent claim 12 recites:

a feed forward controller providing a feed forward control signal to an exposure apparatus based on a thickness measurement of an interlayer of the first patterned wafer substrate for controlling the exposure energy focused on a top layer of the first patterned wafer substrate, and . . .

the top layer being a non-photoresist layer.

In each of claims 1 and 12, the top layer is clearly distinguished from the subjacent layer: a subjacent layer beneath a top layer (claim 1); and interlayer layer ... and a top layer (claim 12). In each case, the layer from which the thickness (or thickness variation) reading is taken, is used to control the exposure energy of a different layer, disposed above the measured layer, i.e. the "top" layer, and this different "top" layer disposed above the measured layer is a NON-PHOTORESIST layer (and henceforth, inherently a device layer).

The Examiner has previously conceded that Park does not teach the above features.

Applicants thank the Examiner for also conceding, in the Interview Summary mailed September 9, 2009 that the Park and Lensing references together, do not teach the above features. In particular, the September 9, 2009 Interview Summary states that: *The Examiner agreed the newly presented amendments of "the top layer being a*

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[TSMC2003-0834]

non-photoresist layer" in claim 1 and "the top layer being a non-photoresist layer" in claim 12 appears to overcome the prior art of Park and Lensing.

The newly cited Toprac reference has now apparently been relied upon to cure the acknowledged deficiencies of the combination of Park and Lensing but Toprac
5 a) does not cure the above-stated deficiencies of the combination of Park and Lensing and b) does not even provide the feature for which it has been relied upon, i.e., Toprac does not even supply the teaching that was alleged to be combinable with Park and Lensing in the first place.

Applicants first point out that Toprac is directed to calibrating critical dimension
10 metrology tools, not adjusting exposure settings. The rejections in the Office action direct the reader to column 5, lines 64-66 of Toprac which begins the description of FIG. 3 of Toprac. An examination of FIG. 3 of Toprac shows that the box labeled "exposure energy" has no incoming signal. That is - no feed forward or feedback signal is delivered to the exposure energy box indicating that the exposure energy is not
15 controlled.

The Examiner relies upon Toprac as follows: "*Toprac teaches to a top layer being a non-photoresist layer*", subject Office action, page 5, line 2. As a first matter, Applicants understand that the Toprac reference is not being relied upon simply for providing a top layer being a non-photoresist layer because Applicants acknowledge
20 that for virtually every semiconductor processing sequence, there are multiple times when the top layer of the substrate being processed is not a photoresist layer.

As such, Toprac has apparently been relied upon for a top, non-photoresist layer that is combinable with Park and Lensing to provide the claimed invention. The Office action states, in paragraph 3 on page 5: *Therefore, it would have been obvious*
25 *to a person of ordinary skill . . . to modify the teaching of Park to include controlling the exposure energy . . . (Lensing . . .); and a top layer being a non-photoresist layer to provide a method and apparatus for performing automatic calibration of critical*

Appl. No. 10/783,495
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[TSMC2003-0834]

dimension metrology tool (Toprac . . .) for minimization of errors to ensure that the multiple layers of semiconductor devices" Applicants respectfully submit automatically calibrating a CD metrology tool is distinguished from controlling exposure energy of one layer of a material based on thickness or thickness variation
5 measurements of another layer of material. Hence, Applicants are unsure as to the particular reason for which Toprac has been relied upon, but Applicants will demonstrate that the invention claimed in claims 1 and 12 is distinguished from any combination of the references cited in the Official action.

Toprac has not been relied upon for and does not teach: measuring the
10 thickness or thickness variation of one layer – a subjacent layer – to control the exposure energy in the patterning of a different layer – a top layer. Toprac has not been relied upon for and does not teach: providing any measurement of a subjacent layer to influence the patterning of a top non-photoresist layer. Further, Toprac has not been relied upon for and does not teach: any feed forward or feedback communication to the
15 exposure system.

Toprac teaches adjusting trim time for semiconductor wafers that include a polysilicon layer covered by a photoresist pattern.

In the sections of Toprac cited for providing a top layer being a non-photoresist layer [subject Office action, page 5, second paragraph], Toprac merely discusses
20 polysilicon layer CD's. Applicants respectfully submit that, in the semiconductor manufacturing art, there is a fundamental difference between a) using thickness or thickness variation measurements of one device layer to control the exposure energy for exposing that same device layer in which a photoresist film is used as a mask to create the pattern in that layer; and b) using thickness/thickness variation
25 measurements of one device layer to control exposure settings of another overlying device layer, i.e., one that is not photoresist. It has been acknowledged that Park and Lensing do not provide this aspect and Applicants respectfully submit that Toprac

Appl. No. 10/783,495
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Attorney Docket No.: N1085-00251
[TSMC2003-0834]

discloses nothing that would suggest combining Toprac with Park and Lensing to provide the claimed features.

Toprac merely provides a polysilicon layer with a photoresist layer formed thereover and performs an additional step on some wafers prior to the etching step used to etch the polysilicon layer using the pattern photoresist as a mask. The extra step simply involves partially etching the photoresist but does not result in complete removal of the photoresist. Hence, the photoresist layer remains the "top layer" and Toprac does not provide the features of a top non-photoresist layer. This extra step merely alters the critical dimensions of the photoresist pattern that remains on the wafer. Column 6, lines 3-4 provides "with the result that the photoresist line width is reduced." Hence, in this case, Toprac's top layer is photoresist and therefore not a non-photoresist layer as claimed. The mere etching of photoresist of some wafers, provides information used to etch that same layer and that same top layer is not a non-photoresist layer.

Even when Toprac's photoresist is eventually removed and the polysilicon becomes the top layer, there is no teaching that any measurement on a layer beneath the polysilicon layer may be used to affect the polysilicon layer. In fact, nothing in Toprac discloses or suggests using any measurement of a subjacent layer to affect anything to do with the patterning of "the uppermost non-photoresist layer" or the photoresist, and especially not the exposure energy because Toprac does not provide any incoming signal to affect the exposure energy.

The mere disclosure in Toprac of providing an additional etching step on the top **photoresist** layer with no controlling of the exposure energy, does not make up for the deficiencies of Park and Lensing as stated supra.

Independent claims 1 and 12 are therefore distinguished from Park in view of Lensing.

Appl. No. 10/783,495
Amdt. Dated 12/09/2009
Resp. to 09/15/2009 Off'l action

Attorney Docket No.: N1085-00251
[TSMC2003-0834]

Claims 3, 4 and 9-11 depend from independent claim 1 and are therefore also distinguished from Park in view of Lensing and Toprac. The rejection of claims 1, 3, 4 and 9-11 under 35 U.S.C. § 103(a), should therefore be withdrawn.

5 With respect to claims 5-8 and 12-22, Saka has apparently been relied upon for teaching measurement of thickness remaining of an interlayer after chemical-mechanical planarization thereof. Saka does not make up for the above-stated deficiencies of Park, Lensing and Toprac, rendering independent claim 1 distinguished from the combination of Park, Lensing, Toprac and Saka. Claims 5-8 are similarly distinguished by virtue of their dependencies from claim 1 and therefore the
10 rejection of claims 5-8 under 35 U.S.C. § 103(a), should be withdrawn.

With respect to independent claim 12, Saka has apparently also been relied upon for providing CD measurement of a second manufacturing lot. Applicants respectfully submit that Saka does not a) make up for the above-stated deficiencies of the combination of the stated references and b) Saka does not even provide the feature
15 upon which it is relied upon. The sections of Saka pointed out on page 12, fourth paragraph of the Office action, do not refer to processing of subsequent lots of material, but rather to *successive wafers of a lot*.

At any rate, Saka does not make up for the above-stated deficiencies of Park, Lensing and Toprac, and because independent claim 12 is distinguished from Park,
20 Lensing and Toprac, claim 12 and its dependent claims - claims 13-22, are also distinguished from the combination of references.

As such, the rejection of claims 12-22 under 35 U.S.C. § 103(a), should be withdrawn.

Appl. No. 10/783,495
Amdt. Dated 12/09/2009
Resp. to 09/15/2009 Off'l action

Attorney Docket No.: N1085-00251
[TSMC2003-0834]

CONCLUSION

Based on the foregoing, each of pending claims 1 and 3-22 is in allowable form and the application in condition for allowance, which action is respectfully and expeditiously requested.

5 The Assistant Commissioner for Patents is hereby authorized to charge any fees necessary to give effect to this filing and to credit any excess payment that may be associated with this communication, to Deposit Account 04-1679.

Respectfully submitted,

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